Barbara Celarent Darii Ferio
Cesare Camestres Festino Baroko
Darapti Disamis Datisi Felapton
Bokardo Ferison
Bramantip Camenes Dimaris Fesapo + Fresi

N S P S
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Mon 9 Germ
Wed. 13 Phis
Tues 17 Chem.
Thurs 18 French

77
98
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3)270
90

M-785

Craig, Locke

Chemistry Lectures Notebook, 1880

Chapel Hill, N. C.

113 pp. Boards 16 x 20 cm.

June 14, 1939

[Lectures by A. F. Redd]

Lectures on Chemistry,

by Prof. A. F. Redd.

L. Craig,

University of N. C.

XVIII

Calcium (Ca)

(III) Ca forms a large potion of the plutonic rocks & occurs in very large quantities forming whole mountain chains of limestone, chalk, gypsum, & mountain-limestone.

(IIII) Ca is obtained by the decomposition of $CaCl_2$ by the electric current or by heating CaI_2 with Na

(IV) Ca is a light yellow metal easily oxidizes in the air & burns with a bright light when heated in air forming CaO $CaO + H_2O$

(VII)(1) Calcium monoxide or lime (CaO).

{(IIII)} Pure lime is obtained by heating white or black marble in the air
It is prepared on a large scale by

heating $CaCO_3$ in kilns by coal mixed with the stone the carbonic acid escapes & quick- or caustic lime remains

{IV} Pure CaO is a white infusible substance combines with H_2O readily giving off great heat forming slaked lime $CaO.H_2O$ wh is soluble in H_2O forming lime-water wh. like the hydrate absorbs CO_2 from the air

{VIII} It is used to make mortar for building purposes & largely used in agriculture 1st to destroy vegetable matter 2nd to liberate potash for plants

The Salts of Ca.

(1) Calcium Carbonate or Carbonate of Ca $(CaCO_3)$

{III} $CaCO_3$ occurs most widely diffused as chalk limestone coral & marble

IV It occurs crystallized in two forms so it is dimorphous. It is almost insolu-

ble in pure H_2O but readily desolves in H_2O that contains CO_2 making temporary hard H_2O H_2O hard with desolved carbonate may be softened by the addition of CaO suspended in the H_2O in such a quantity that the excess of CO_2 is neutralized

(2) Calcium Sulphide ($CaSO_4$)

III) This occurs in nature as a mineral termed Anhydrite + combined with $2H_2O$ as selenite gypsum or alabaster

IV) It is soluble in 400 parts of H_2O + often found in spring H_2O making permanently hard. Gypsum when heated loses its H_2O + is then called plaster of Paris when moistened it takes up two parts of H_2O + becomes a solid

Gypsum also used to fertilize

(3) Calcium Chloride ($CaCl_2$)

III) It is formed when limestone or marble is desolved in HCl + if the solution is evaporated colourless needle shaped crystals

of the hydrated chloride $CaCl_2 + 6H_2O$ are formed when these are dried the substance still retains $2H_2O$ & forms a porous mass wh. takes up moisture & is used for drying gases when more strongly heated it parts with all its H_2O

(4) Bleaching Powder or chloride of $Ca(OCl)(CaCl_2, Ca(OH)_2)$
(IIIII) It is obtained by the action of Cl on slaked lime

(5) Calcium Fluoride or Fluor Spar CaF_2
(III) Found crystallized in cubes in Derbyshire & Cumberland

(V) When heated with H_2SO_4 calcium sulphate & HF are formed; thus,
$$H_2SO_4 + CaF_2 = CaSO_4 + 2HF$$

VIIIII It is sometimes used as a flux in the reduction of metals whence its name Fluor Spar

Among the remaining compounds of Ca may be mentioned $Ca_3P_2O_4$, CaS an insoluble substance + CaS_5 a soluble salt.

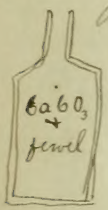
Lecture on Ca.

(III) Ca occurs in the bones of the body as $Ca_3P_2(PO_4)$ also in the teeth

Prepared by the baby

Lime Call

$CaCO_3$ + heat = $CaO + CO_2$. The reason for getting it into Call is because this is soluble



The salts of Ca are $CaCO_3$ $CaSO_4$ $CaCl_2$ $Ca(ClO)_2$ + CaF_2 $Ca_3P_2(PO_4)$ CaS + CaS_5

$CaCO_3$ is formed by passing CO_2 through lime H_2O as, $Ca(HO)_2 + CO_2 = CaCO_3 + H_2O$

$CaCl_2 + Na_2CO_3 = CaCO_3 + 2(NaCl)$

$CaCO_3 + H_2SO_4 = CaSO_4 + H_2CO_3 = H_2O + CO_2$

$CaCl_2 + 2ClO$ is used as a disinfectant

Mortar = Call + H_2O + sand it gets hard owing to the $CaCO_3$ + also to the silicate

Hydraulic cement contains a little Fe owing to wh. it gets hard under H_2O

XVIII
Barium (Ba)

(II) Ba occurs in barium sulphate or heavy spar & barium carbonate or witherite

(III) Barium metal has not yet been obtained but the metalic powder may be formed by the action of an electric current on fused $BaCl_2$

(IV) Its properties are like those of Ca. W. 137

(VII)(I) Barium Monoxide or Baryta (BaO)
{III} The best way to form it is by decomposing the nitrate by heat $Ba2(NO_3) + heat = BaO + N_2O_5$

{IV} It is a greyish porous mass fuses at a high temperature & takes up H_2O evolving much heat forming a crystalline hydrate $H_2BaO_2 + 8H_2O$ wh. is soluble in

twenty parts cold H_2O & the solution on exposure to the air rapidly absorbs carbonic acid & becomes chalky

1) Barium Dioxide BaO_2.

{IIII} formed when BaO is heated in O then additional atom of O will be given off at a higher temperature It has been proposed to make O in this way but it don't work in practice

There are no salts known corresponding to this oxide

Salts of Barium.

1) Barium Chloride ($BaCl_2$)

{IIII} Formed by dissolving the native carbonate in HCl. thus; $BaCO_3 + 2HCl = BaCl_2 + H_2CO_3$

{IV} This soluble salt is one of the most important compounds of Ba. It crystallizes in flat scales containing $2H_2O$

5

(2) Barium Sulphate $BaSO_4$

{III} It falls as a white crystaline precipitate when any soluble Ba salt is brought into a solution of sulphate

{IV} occurs native as heavy spar crystallizes It is one of the most insoluble salts known sp. gr. = 4.6

{VIII} It is used as a paint + the ground native heavy spar is largely used to adulterate white lead.

(3) Barium nitrate $Ba(NO_3)_2$ a soluble salt

(4) " Sulphide BaS obtained by heating $BaSO_4$ with coal $2\,BaS + 2H_2O = Ba(OH)_2 + Ba(HS)_2$ both of wh. are soluble in H_2O

(5) $BaCO_3$ - Barium Carbonate an insoluble salt

(6) Barium Silicofluoride insoluble in H_2O

(7) " phosphate " " " "

The volatile salts of Ba give a green colour to the flame

XIX

Strontium (Sr)

Sr is analogous to Ba + Ca but is a crimson flame

Sr Cl = Ca(HO)$_2$ } Sometimes called
" " Ba - Ba " } anhydrous caustics
" " Sr = Sr "

+ so oxide Ba Sr + Ca. All their salts are white + all are characterized by a flame
Sr. Sr only two salts are soluble Sr Cl(HO$_2$)
+ Ba. H$_2$. There are two insoluble salts
strontianite + celestine found native.
The Cl. bonates of these three metals are insoluble
" chlorides " " " " " soluble in H$_2$O
They are all basic + agree in physical +
chemical properties

XX

Copper (Cu)

II) Cu has been known for a long time

III) Metallic Cu found in N. America + elsewhere

The following minerals contain Cu
also found in the mines of Chili & S. Australia
The chief sources of Cu are the following ores
(1) $Cu_2S + Fe_2S_3$ = copper pyrites
(2) Cu_2S = cuprous sulphide
(3) $CuCO_3 + Cu(OH)_2$ = Carbonate or malachite
(4) Cu_2O = Red or cuprous oxide

(III) Cu may be obtained by reducing Cu_2O in H_2
or by the electrolytic decomposition of a salt of Cu
To get it on a large scale from $CuCl_2$ or Cu_2O
reduce the ore with C in a wind furnace

(IV) Cu has a peculiar deep red colour & is
very malleable ductile & tenacious. It melts at
a red heat & slightly volatile at a white heat
giving green fumes & a flame if CH_4 which is famous
It is one of the best conductors of heat
& electricity. Cu does not oxidize in the air except
when heated when it oxidizes to scales of copper
oxide. It crystallizes in cubes or octahedra W. 63.5
Cu does not decompose steam

(V) $Cu + 2HCl = CuCl_2 + 2H$ $3Cu + 8HNO_3 = 3Cu(NO_3)_2 + 4H_2O + 2NO$
$Cu + 2H_2SO_4 = CuSO_4 + SO_2 + 2H_2O$.

Alloys of Cu

Many are important

Brass = 2/3 Cu + 1/3 Zn harder than Cu & can be worked often & improves this base

Yellow or Muntz-metal = 60% of Cu used in sheathing ships. Bronze, gun-metal & speculum-metal & tin are other alloys

These are brittle if cooled slowly from red heat but malleable if cooled quickly: as by dipping in cold H_2O

Compounds

Cu forms two sets of compounds Cupric (wh. contain one atom of Cu) & Cuprous (wh contain two atoms of Cu)

Cupric Compounds

Copper monoxide, Cupric or Black Oxide Cu(II) CuO formed when Cu is heated in Air or when $Cu(NO_3)_2$ is heated to redness

$Cu(OH)_2$ is obtained as a blue precipitate when a caustic alkali is added to a cupric salt

(V) CuO is soluble in acids

y acid crystalliging salts. It forms the blue & green cupric salts. The salts are -

(I) Copper Sulphate $CuSO_4 + 5H_2O$

(III) $CuO + H_2SO_4 = CuSO_4 + 5H_2O$

(IV) It crystallizes in large blue crystals when heated to redness it loses its H_2O & forms a white powder wh. at higher temperature decomposes i.e. e.g. CuO ....

(VIII) Employed in calico-printing & to make Scheele's (& Brunswick) green & other Cu pigments $CuSO_4$ & other Cu salts give with excess of NH_3 ($CuSO_4 + 4NH_3$) give a deep blue coloured solution wh. may be used as a test for Cu.

(2) Copper nitrate $Cu2(NO_3) + 6H_2O$
(III) $3Cu + 8HNO_3 = 3Cu2NO_3 + 2H + 4H_2O + 2NO$
(IV) Very soluble & crystallizes in blue prisms

(3) Copper chloride $CuCl_2 + 2H_2O$
(III) $Cu + 2Cl = CuCl_2$ or $Cu + 2HCl = CuCl_2 + H_2$

IV) Salts form needle shaped crystals soluble in H_2O & alcohol. The alcoholic solution burns with a characteristic green flame. $CuCl_2$ absorbs O_2 it is a whitish solid

(4) Copper Sulphide (CuS)

III) H_2S + acidified solution of Cu salts ($CuCl_2$)

IV) Salt as a black precipitate

(5) Copper carbonate $CuCO_3$ not in pure state

6) " arsenite

Cuprous Compounds.

Cuprous Oxide or Red Oxide Cu_2O

III) Occurs in ruby red octahedral crystals

III) $CuCl_2 + Cu \xrightarrow{\text{heat}} Cu_2Cl_2$ or by boiling $CuSO_4$ + sugar + excess of caustic potash Cu_2O is precipitated as a bright red powder

IV) Salt gives to glass a splendid ruby red colour.

(V) Salts form colourless salts which absorb O & pass into cupric compounds

The most important of these salts is Cu_2Cl_2 a white solid substance obtained thus

$CuCl_2 + Cu + 2\,HCl = Cu_2Cl_2 + H_2O$ (see top of salts in Roscoe on 268 page

Lecture on Cu

In the cuprous compounds Cu acts as a Monad: in the cupric compounds it acts like a ~~tri~~diad. Thus is the explanation

$Cu \cdot O$ making CuO

$Cu-$ / $Cu-$ $> Cu_2O$ making Cu_2O } As in Fe which see

The cupric salts are green & blue the cuprous salts are colourless

Formation of the Salts.

$Cu + 2HCl = CuCl_2 + 2H$

$3Cu + 8HNO_3 = 3\{Cu2(NO_3)\} + 4H_2O + 2NO$

$Cu + 2H_2SO_4 = SO_2 + CuSO_4 + 2H_2O$

$H_2S + CuCl_2 = CuS + 2HCl$

$Cu_2O + H_2SO_4 = Cu_2SO_4 + H_2O$

$CuSO_4$ with arsenite of soda is used to form Schuler's green

$CuCl_2 + 3CuO \rightleftharpoons$ Brunswick green & not formed from $CuSO_4$

XXII

Zinc (Zn)

III) The chief ores of Zn are zinc sulphide or blende, the carbonate or calamine, & the red oxide.

IIII) Zn is obtained by roasting the ore & exposing it to a high temperature in the air so as to convert the ZnS or $ZnCO_3$ into oxide it is then mixed with fine coal or charcoal & strongly heated in crucibles or retorts of peculiar shape the CO comes off & Zn distils over & may be condensed

IV) Zn is a bluish white metal exhibiting crystalline structure. It is brittle at the ordinary temperature but when heated to about 130° it may be rolled out or hammered into sheets if heated to 200° it is again brittle Zn melts at 423° & at a bright red heat it begins to boil & volatilizes or if air is present it takes fire & burns with a luminous greenish flame forming ZnO

Zn is resisted on by dilute acids & so used in the form of sheets & is employed as a covering for Fe wh. when thus protected is said to be galvanized

(V) Zn easily dissolves in dilute acids forming H & it is thus used in the oxidizable portion of the galvanic battery

Brass = Cu Zn

German silver = Zn + Nickle + Cu

Compounds of Zn

Zinc oxide (ZnO) = only oxide of Zn

(III) Obtained by burning Zn or by precipitating a soluble Zn salt with an alkali & then heating the precipitate

(IV) ~ill is an insoluble white powder wh. when heated becomes yellow but loses this colour on cooling

(V) It dissolves easily in acids making the Zn salts. It is used as a pigment — Zinc White

1) Zinc Sulphate $ZnSO_4 + 7H_2O$ (White vitriol)
It is a soluble salt crystallizing in long prisms
It forms a series of double salts with alkaline
precipitates

(2) Zinc Chloride $ZnCl_2$
It is a white soluble deliquescent substance
(III) $Zn + 2HCl + (Dry) = ZnCl_2$ or $Zn + 2HCl = ZnCl_2 + H_2$

3) Zinc Sulphide ZnS (Blende)
(III) It is obtained as a white gelatinous precipitate insoluble in acetic but soluble in
mineral acid formed when an alkaline
sulphide is added to a soluble zn salt
IV It occurs as a crystalline mineral generally
coloured by Fe + other impurities

4) Zinc Carbonate $ZnCO_3$ (Calamine)
It is an insoluble substance & cannot
be prepared by precipitating a solution of zn
salt by an alkaline carbonate as oxide is
precipitated with the carbonate

Lecture on Zn

$ZnSO_4$ is called white vitriol
$FeSO_4$ " " green "
$CuSO_4$ " " blue "
Blue & white vitriols are used as emetics

Zn of this country is prone to pass
Silesian Zn is very common
Zn dust is used for paint instead of lead
because it is not blackened by H_2S &
because it dont give painter the colic

Test for Zn - A Zn compound + solution of
cobalt heated on charcoal gives a green
colour

XXIII

Mercury (Hg = Hydrargyrum)

(III) Hg occurs native but the chief ore is the sulphide (cinnabar) wh. occurs at Almaden in Spain at Idria in Illyria in California & in China & Japan

(III) Hg is obtained by roasting the ore SO_2 goes off the Hg volatilizes & they may be condensed in earthen pipes

(IV) Hg is the only element liquid at the ordinary temperature; it freezes at -40° crystallizing in octahedra; in the solid state it is malleable having the sp. gr. of 14.0. It boils at 350° & gives off a little vapour at ordinary temperatures wh. is 7 times as dense as air 100 times as heavy as H. Hg does not tarnish in air but when heated over 300° it absorbs O & passes into a red oxide. Wt. of 100 cc. sp. gr. 13.596. D 100

(V) Hg combines directly with Cl Br I & S HCl does not attack Hg. $Hg + H_2SO_4 + heat = SO_2 + HgSO_4$ $Hg + HNO_3 =$

(VIII) Hg is used for extracting gold & silver from their ores & for silvering looking glass also used as a medicine.

Test for Hg.— It is deposited from a solution on metallic surface in forming gray powder wh. becomes bright on burnishing

Mercury in dyad & like Cu forms its
salts & compounds Mercurous & Mercuric
& it acts like a monad in mercurous compounds
= Mercuric compounds

Mercury monoxide or Mercuric oxide HgO
(IIIII) It is obtained by moderately heating
$Hg_2(NO_3)_2$ or by heating Hg in air for some time
at 303°
(IV) Thus prepared it appears as a red
crystalline powder. By precipitating it from
$Hg_2(NO_3)_2$ with KHO it forms an amorphous
yellow powder

Mercuric Nitrate $Hg(NO_3)_2$
(IIIII) $Hg + 2HNO_3 = Hg(NO_3)_2 + H_2$ or $HgO + 2HNO_3 =$
$Hg(NO_3)_2 + H_2O$

= Mercuric Chloride or Corrosive Sublimate. $HgCl_2$
(IIIII) Formed by heating $HgSO_4$ + common salt
$HgSO_4 + 2NaCl = HgCl_2 + Na_2SO_4$
also thus $Hg + Cl_2 + Fe = HgCl_2$

IV. It is soluble in H_2O crystallizing in

rectangular octahedra fuses at 265 & boils at 295

(V) When NH_3 is brought into a solution of $HgCl_2$ the white precipitate is thrown down it is a chloride of mercury-ammonium NH_2HgCl

(VI) Violent poison

Mercuric Sulphide, Cinnabar, or Vermilion (HgS)

(III) Occurs native & may be prepared by heating a mixture of Hg & S

(IV) When precipitated from a solution of a mercuric salt by H_2S it forms as a black amorphous powder but on sublimation it becomes red & crystalline. (VII) Violent poison

Mercurous Compounds

= Mercurous Chloride or Calomel. Hg_2Cl_2

(III) Formed by heating 3 parts of Hg with 4 parts of $HgCl_2$. $HgCl_2 + Hg = Hg_2Cl_2$ when it sublimed into a solid cake it must be ground fine & washed to get $HgCl_2$ out

(IV) & (V) is a white powder insoluble in H_2O

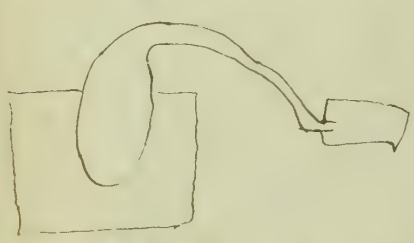
+ decomposed by potash + NH_3
(V. III) used largely in medicine

Mercurous oxide Hg_2O
(I III) I2 obtained by digesting Hg_2Cl_2 by KHO

(IV) It is a black powder on exposure to light or when heated to 100° it decomposes into Hg + HgO

Mercurous-nitrate $2\,HgNO_3$
(III III) I2 obtained by acting with dilute HNO_3 on excess of Hg

Lecture on Hg.
(III) $HgS + heat + O = SO_2 + Hg +$ some HgO



Am. Hg comes from Cal.

HgO formed by heating Hg this in air

$HgCl_2$ has a styptic taste + we get it out of the stomach by Graham's law of dialysis
Test for $HgCl_2$ — $HgCl_2$ is soluble in H_2O +

Hg_2Cl_2 is insoluble & so has no taste

Test for Mercuric Salts.

ic salt ($HgCl_2$) + $2KI$ – HgI_2 + $2KCl$

They are all formed by solution in acid except the Chloride

Hg_2Cl_2

(III) $Hg_2(NO_3)_2$ + $2KCl$ Hg_2Cl_2 + $2KNO_3$

gives a white precipitate & may be used as test for ous salts

To form ous salts act on Hg in excess in cold.

All the salts of Hg are volatile

Test for Hg

If you heat a compound of Hg in a closed tube it volatilizes & Hg falls in dark globules

III Used to act on the living & in excess as solvent poison

(Potassium)

(Potassium (K = Kalium)

(II) K was discovered in 1807 by Sir Humphrey Davy by decomposing dek with altadi in into K & O + H. by current of electricity

(III) K occurs in the earth in the form of K_2CO_3 KNO_3 KCl with occurs in beds in Staszfurt, Germany. Sea H_2O is now used to get K compounds

(IIII) K is prepared by heating together C + potash to high temperature in an iron retort CO comes off + K distils over this must be distilled again to get it pure There must be great precaution in preparing it as it burns so readily

(IV) K is a bright silver white soft metal at 0° it is brittle melts at 65.2° when it becomes pasty when heated below red heat it sublimes yielding a fine green colour vapour

(V) It rapidly absorbs O from air becoming white oxide. When placed in H_2O so much heat is generated in its taking O that it burns with a purplish flame giving H_2O an alkaline reaction thus, $H_2O + K = KHO + H$. K also combines with S + many other non metals giving off heat + light

(VII) K forms three oxides
(1) Potassium Monoxide K_2O
(2) " dioxide K_2O_2
(3) " tetroxide K_2O_4

(VIII) It is obtained by allowing thin pieces of K to oxidize in dry air

(IV) It is a greyish white brittle substance melts at little above the red heat + volatilizes at a very high temperature

(V) It combines with H_2O with much heat: thus, $K_2O + H_2O = 2KHO$ & it does not decompose into H_2O

K_2O_2 + K_2O_4 are produced when K is oxidized at high temperatures

---

Potassium Hydroxide or Caustic Potash (HKO

(III) $K_2O + H_2O = 2HKO$ or $K_2CO_3 + 12H_2O + 6a(HO)_2 =$ $6aCO_3 + 2HKO$. $CaCO_3$ falls as a heavy powder leaving 2HKO in solution the clear liquid is evaporated in a silver dish to dryness fused + cast into ~~molds~~ sticks in a metalic mould

(IV) HKO is a white substance soluble in ½ its weight in H_2O + acts as a powerful cautery destroying the skin

(VIII) Used to make soap + also in laborato

Potassium Carbonate Potashes or Pearlashes K_2C

(II) Found in Russia + America + in the leaves + twigs of plants

(III) By boiling out the ashes of plants with H_2O + evaporating the solution to dryness + may be obtained pure by separating th

purification by crystallization. It can be obtained perfectly pure by heating pure potassium bicarbonate to redness & separating the carbonate formed by dissolving in H_2O It absorbs H_2O from the air & is very soluble it turns red litmus blue or has alkaline reaction

---

Hydrogen Potassium Bicarbonate or Potash ($HKCO_3$)

III) $CO_2 + K_2CO_3 =$

It may be considered as dibasic to O_1 H_2CO_3

IV) It is a white salt & not so soluble as K_2CO_3. It is neutral to litmus nearly

---

Potassium Nitrate, Nitre, or Saltpetre (KNO_3)

II) Occurs as an efflorescence on the soil in dry tropical countries especially India

III) By nitrification in which animal matter (containing N) mixed with wood-ashes & lime is exposed to the air: the organic matter gradually oxidizes HNO_3 being formed

with water with the CaCl & potash to form nitrate. The salt is obtained by boiling out the deposit with H_2O adding K_2CO_3 to decompose the $Ca2(NO_3)$ & allowing KNO_3 to crystallize out

(IV) KNO_3 crystallizes in rhombic prisms & dissolves in 7 parts of H_2O at 15° & in its own weight of hot H_2O. Nearly half its weight is O. It parts with on heating with C or any other combustible substance

(VIII) Used to make gunpowder & fireworks

Gunpowder

consisting an intimate mixture of KNO_3 charcoal & S. When it is fired O of KNO_3 combines with the charcoal forming CO_2 & CO whilst N is liberated & S combines with K; hence it can burn anywhere as it contains its own O Explosion is due to evolution much gas & a rapid rise of temperature
Best powder contains 2 molecules of KNO_3 to one of S & 3 of C

Potassium chloride KCl

I) Occurs in certain saline deposits as at Stassfurt also in sea H_2O

IV) It crystallizes in cubes & used to make other salts of K

Potassium chlorate ($KClO_3$)

(III) $3Cl_2 + 6KHO = KClO_3 + 5KCl + 3H_2O$

$Ca2ClO_3 + 2KCl = CaCl_2 + 2KClO_3$

IV) It is slightly soluble in cold H_2O separating in large tubular crystals whilst the soluble $CaCl_2$ remains dissolved

Potassium Iodide (KI)

III) Obtained by dissolving I in KHO & evaporating & igniting the solid mass to redness

V) Very soluble & crystallizes in cubes

Potassium Sulphate (K_2SO_4)

II) Found in the ashes of both sea & land plants

IV) It is slightly soluble in H_2O. A second

sulphate termed hydrogen potassium sulphate $HKSO_4$ is soluble + obtained in making HNO_3

Potassium Sulphides

They are K_2S K_2S_2 K_2S_3 + K_2S_5 they are soluble evolve H_2S when heated with an acid + not used in the arts

$H_2S + HKO = KHS + H_2O$. HKS = hydrogen potassium sulphide

General Characteristics of K Compounds

All give a violet colour to flame

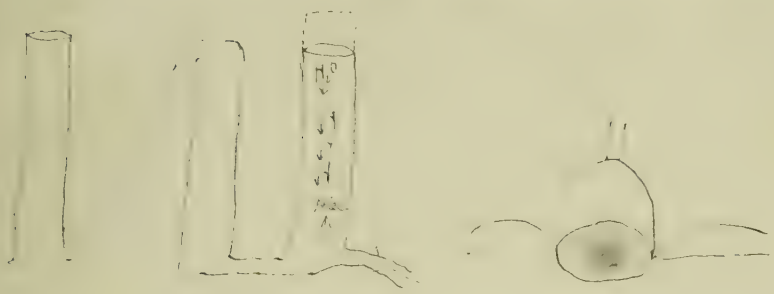
Almost all the salts are soluble the 3 most insoluble are - (1) potassium perchlorate. (2) hydrogen-potassium tartrate (3) potassium platinum chloride

XXIV

Sodium (Na)

(Fig.) As occurs in Rock Salt + Sylvine in mines the rock is as brilliant crystals

Showing the formation of Na_2CO_3



(1) $2\,NaCl + H_2SO_4 = Na_2SO_4 + 2\,HCl$

(2) $Na_2SO_4 + 4C = Na_2S + 4CO$

(3) $Na_2S + CaCO_3 = Na_2CO_3 + CaS$

All the salts of Na are soluble except the compound with antimony

Process by which used

$NaCl + H_2O + CO_2 + NH_3 = NaHCO_3 + NH_4Cl$

K & Na are very much alike except that K is the more intense. Na is used for lit

XXV

Tin (Sn)

[illegible] tin [illegible] [illegible]
[illegible] [illegible] [illegible]. [illegible]
[illegible] [illegible] H_2S [illegible] [illegible]
[illegible] $SnCl_4 + 2H_2S = SnS_2 + 4HCl$
[illegible] [illegible] [illegible] [illegible]
[illegible] [illegible] $SnCl_2 + 2H_2S = SnS_2 + 4HCl$
$SnCl_2 + 2HgCl_2 = SnCl_4 + Hg_2Cl_2$
$SnCl_2 + Hg_2Cl_2 = Hg_2 + SnCl_4$

XXVI

Aluminium (Al)

The great [illegible] of Al is shown also by
$2SiO_2 + Al_2O_3 + 3H_2SO_4 = Al_2(SO_4)_3 + 3H_2O + 2SiO_2$
[illegible] the [illegible] in Al [illegible] $Al_2(SO_4)_3 \cdot x H_2O$
[illegible] (= [illegible] [illegible] [illegible] [illegible]
[illegible] [illegible] [illegible] [illegible] [illegible]
[illegible] [illegible] [illegible] [illegible] by Nitrate
[illegible] $Al_2K_2SO_4 + 24H_2O$, $Al_2(SO_4)_3 + K_2SO_4 + 24H_2O$
[illegible] $Al_2(SO_4)_3 + K_2SO_4 + 24H_2O$ [illegible] [illegible]
[illegible] [illegible] [illegible] [illegible] [illegible]
[illegible] [illegible] [illegible] [illegible] [illegible]

... Al. Mixture would fail
... (Calcium) CaO (SiO_2) is used to
... take the place of Al.
... test for Al.
... H_2S + ammonium acetate yellow ppt
... Al
... ppt Al in ammoniacal medium
... ppt is due to ...
... ing again.

XXVII.

Magnesium (Mg)

... Mg is found ... Add ...

$$MgCl_2 + BaCl_2 + 2(NH_4)_2SO_4 = BaSO_4 + MgSO_4 + 4NH_4Cl$$

$$MgSO_4 + BaCl_2 = BaSO_4 + MgCl_2$$

$$MgCl_2 + 2Na = Mg + 2NaCl.$$ Mg ...
... put on ...

Test for Mg

$MgNH_4PO_4 + 6H_2O$ ... $(NH_4)_2$
... test is $(NH_4)_2PO_4$. ... a white ppt ...
... precipitate. Mg gives a grassy feeling to ...

XXVIII

Cobalt + Nickel (Co + Ni)

[illegible]

[illegible]

[illegible]

[illegible]

XXIX

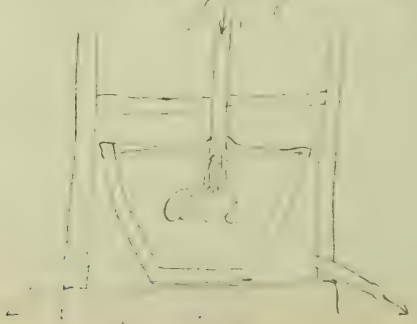
Platinum (Pt)

(a) [illegible]

(b) $PtCl_2 + 2KCl + Pt \rightarrow 2KPtCl_3 + Cl + 2H_2O$

[illegible]

$PtCl_2 + 2KCl \; (PtCl_2 + 2KCl)$



Deckel

(C) Pt reacts in various forms

1 Spongy Pt ignited by a blast of air is attacked by the fumes of P and S and much more readily if combining gases & can convert alcohol into ethylene

2 – Pt Black prepared by adding an alkali to Pt in the presence of an alkali by electrolysing Pt

Pt is much more important as it forms double salts with the alkali metals K & NH_4

Pt used to make in apparatus for making H_2SO_4 & in Germany to make SO_3 it is useful in analytical chemistry on account of its chemical properties it is unacted on by any single acid it is unaffected at any ordinary temperature & is not tarnished by air in even when exposed to H_2S to a moderate extent

Reducing substances ignite Pt caustic alkalies except carbonate at high heat & P S & Br & Cl readily tarnish when not to be used with Pt as Pb Sb Bi Sn

Test for Pt in the reaction is to be given

XIX

Gold (Au)

(I) Gold is found in the native state in alluvial deposits & also in slate rocks. Siberia is a great home of gold. Ag occurs in this state mixed with Ag Te & Sb & pyrites

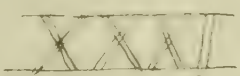
(II) To find the quantity of Au in the bottom then wash it after which mix with Hg the Hg may be distilled off then take from Au the base metals by HNO_3 + HNO_3 then dissolve the Au in aqua regia & precipitate with $FeSO_4$ when you get the black powder then fuse under borax & cast into ingots & so to factories

Au is taken from sands by washing

Salts of Au

Chiefly the only important one is chloride by dissolving Au in aqua regia when you get $AuCl_3$ + HCl ($AuCl_3$ + HCl) & by other methods Au Cl_3 (red brown colour

VIII) As used as a currency [illegible]
[illegible] 1st density
and dont oxidize
When it is used for ornaments + luxury
also used in electricity for wires
it is for this is its not being attacked
by the air + then it can be used
without heat. when it is used in
coiling



Silver (Ag)

III) Ag [illegible] + California

IIIII)

Pb is absorbed + Ag is
[illegible]

$Ag_2S + 2Hall - 2AgHal + H_2S$
$2.AgHal + H_2 = 2HeHal + Ag_2$

$Ag_2O + Ag_2O + Ag_2O_3$ are the oxides of Ag

AgCl AgBr AgI AgBr AgCN + Ag_2S are the
[illegible] of Ag

$Ag NO_3 + HCl \rightarrow AgCl + HNO_3$

$Ag NO_3 + NaCl \rightarrow AgCl + NaNO_3$

Ag Cl is insoluble in HNO_3 & soluble in NH_3 it is a test for Ag

$Ag NO_3 + KCl = AgCl + KNO_3$

$AgCl + KNO_3 + HNO_3$

$AgCl + KNO_3 + HNO_3 + 2(NH_4)HO = NH_4NO_3 + H_2O + AgCl + KNO_3 + (NH_4)HO$ now $NH_4NO_3 + H_2O + AgCl + KNO_3 + (NH_4)HO + 2HNO_3 = NH_4NO_3 + H_2O + HNO_3$ all the rest alike

(VIII) Ag is used to harden & preserve in large quantities it is violent poison used also for currency ornament & the chemical property is to render it insoluble for use in Ag is the coldness with which it is tarnished by H_2S forming Ag_2S

Ag largely used for guilding also for ornaments Test — KAg salt readily given it is used much used in the laboratory except to prepare $AgNO_3$ & $NaNO$

XXXII

Arsenic (As)

Marsh's Test

Put [illegible] in a test tube with H_2SO_4 then add to the apparatus while the H_2 is [illegible] by a solution of As & the flame will [illegible] & a pale blue will be deposited on a cold surface (a porcelain) this can be dissolved by a solution of HCl. Arsenious acid [illegible] in the same way.

Process for getting As

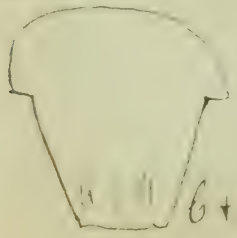
[illegible] the tissue or stomach [illegible] with [illegible] & when cold a little [illegible] the chopped up mass put the water [illegible] with them add potassic chlorate from time to time until the whole mass is thoroughly broken up & yellow from the liberation of Cl. The effect of Cl & $KClO_3$ is to liberate Cl to destroy any [illegible] matter as stomach is [illegible] & to bring the whole mass into a homogeneous solution then filter then evaporate then filtrate until the [illegible]

then pass SO_2 through the solution until the arsenic has been reduced to arsenic then pass H_2S through the solution for 24 hrs until all the As is precipitated as sulphide then subject to all the tests

The substance that comes out of the mint is As_2H_3 (arseniuretted H) + is decomposed by heat into As + probably H_2O + As is deposited on the porcelain As_2H_3 is one of the most poisonous substances known

(II) As recovered with S to Fe + Sb if in abundant

(III) Heat the ore to convert it into As_2O_3 the is placed in a furnace like As_2O_3 is sublimed into the air is condensed in the upper part



(V) to connect it with the white
(VI) " " " " " "
it in analogous with Ta + Ti
about. It boiled with the
of oxidation + formation of
connected it with the
Ta has less unfavorable oxides Ta$_2$O$_5$ + Ta$_2$
Ta$_2$O$_3$ is of the least importance

Ta_2O_3

is formed by heating Ta in the
least to in air it has a fine
is changed to white fumes Ta$_2$O$_5$

Ta occurs in three forms the common
form is a white powder looking and
is fragments have a metallic taste
and crystallized in sparkling octa-
hedra best seen under a microscope
from 30 to 0 diameters
and harder than
Ta$_2$O$_5$ is common and known as white
Ta
Ta is not [illegible] fusion at

Na_3AsO_4 corresponds to Na_3PO_4
Na_2HAsO_4 " " Na_2HPO_4
NaH_2AsO_4 " " NaH_2PO_4
$Mg(NH_4)PO_4$ } Test for As
$Mg(NH_4)AsO_4$ }

As has been found in the body 17 yrs after burial it may be found in the hair but has never been found in the hair of a child found in any of the tissues As exists such as preserving influence that the liver is nearly good for 15 yrs it smells like cheese
After you can see the As in the liver as arsenic sulphide.
Sometimes it does not preserve the body it is said to harden the body
VIII) Used to preserve bird skins & it was on a print that caused many deaths in London some time ago. Sometimes used to colour candy to look like it & it is used in the last name by for rebuild

$6Zn + 6H_2SO_4 + As_2O_3 = 2AsH_3 + 6ZnSO_4 + 3H_2O$
$2AsH_3 + \text{porcelain} = 2As + 3H_2$

$As_2O_3 + 6KHO = 2K_3AsO_3 + 3H_2O$
$3As_2O_3 + 4HNO_3 = 3As_2O_5 + 2H_2O + 4NO$

$CuHAsO_3$ } - Scheele's green
$Cu_2As_2O_3$ }

XXXIII

Antimony Sb

Sb lead or dull black colour

Sb " " glistening "

$Sb_2O_3 = Sb_2O_3 + As_2O_3 - Sb_2O_3$

with nitric acid

(III) $Sb_2S_3 + Fe_2 = Sb_2 + 3FeS$

(VII) Used to form lifer with Pb in its alloy in the mould to make the edge sharp

$2SbCl_3 + 3K_2CO_3 = Sb_2O_3 + 6KCl + 3CO_2$

$SbCl_3 + H_2O = 2HCl + SbOCl$ = oxychloride + Sb a white efflorescence

Sb_2O_5 is formed by acting on Sb with HNO_3

Metantimonic acid forms an insoluble sodic salt

$Sb_2O_5 + 2H_2O = Sb_2H_4O_7$

As & Sb are analogous in chemical relations & made the same principles in solubility Appearance & generally associated in nature

The forms of the bioxides cannot be used as a test for either as both have form in needle shaped octahedra & amorphous

VIII) Sb used as a medicine to allay inflammation of the lungs & in cholic in excess it acts as a violent poison & its symptoms are like those of As & used to be confounded

XXXIV

Bismuth (Bi)

I) Found native in Silesia also combined with S Se Te & with O in Bismite

II)

Heat impure Bi in a large crucible with KNO_3 until the whole mass attains quiet fusion. Bi will then settle in a layer of considerable purity

To enable to make it pure dissolve Bi in HNO_3

[illegible] $Bi_2(NO_3)_3 + 3H_2O$ then add H_2O and get $BiNO_3(HO)_2$ But nitrate of Bi [illegible] is sold in commerce. When it is mixed with chalk + used for cosmetics [illegible] etc. $BiNO_3(HO)_2$ [illegible] used in medicine

$Bi(NO_3) + 5H_2O$ is the most important salt of Bi in the shape in which you put Bi.

Bismuthate Bismuthal

Bismuthal is not soluble in tartaric acid

Bismuthol " " " " " "

So we can distinguish them

(IV) Bi is the most easy to separate from all metals if you melt about 5 lbs Bi + pour into a form shape then a little crust has formed pierce it with iron rod then pour out the Bi + on the sides we find beautiful shining cubic crystals

Bi is done by the physical properties in consequence for instance the more you heat it the [illegible] it stays in. Bring it increase $\frac{1}{32}$ of its volume [illegible] all metals [illegible] like

one great use of Bi is to form fusible
metals - Pb + Sn + 2 Bi melts at ca. 5°C
Fusible metal used in thermostats
Bi + Cl
$BiCl_3 + H_2O \rightarrow BiOCl + 2HCl$
$Bi_2(NO_3)_3 + 2H_2O \rightarrow BiO(OH)_2 + 2HNO_3$
The analogy between Bi + Sb or As
only through the nitrates

Chromium (Cr)

(IV) Cr has a pentavalent state as in the oxide + it is also trivalent + in the ox Cr_2O_3 + $CrCl_3$ are the important ones. Some of the compounds of Cr have a yellowish green tone + some are red. Confusion of Cr ions among themselves
Cr_2O_3 = dark green - the CrO_6
$2Na_3 + Cr_2O_3 = Cr_2Cl_6 + 3H_2O$ same as $2H_3CrO_6$
$Cr_2O_3 + CrCl_6 + C_3 = 3CO + Cr_2Cl_6$. Cr_2Cl_6 crystallizes
$CrO_3 + H_2O$ H_2CrO_4 analogous to H_2SO_4 + H_2
$H_2CrO_4 + H_2SO_4 = 2CrO_3$ - red crystals
(IX) Colours borax green $2K_2CrO_4 + Cr_2O_3 = 2CrO_4$
(VIII) Fr paint + colour for porcelain + $2HCl$

Glass

Glass is an amorphous silicate of
[illegible] amorphous because some silicates
of K + Na [illegible] are crystalline +
could not be used for glass.
There are two kinds of glass in chem
istry <u>lead</u> free glass + <u>lead</u> glass.
The introduction of Pb changes the
the physical properties of glass
makes its melting point lower
gives it greater, refractive + sparkling
power to be used in the form
+ by H_2S. Lead glass is commonly
made of K + called flint glass
crown glass — Na + Ca
Bohemian " K + Ca
Flint " K + Pb
Bohemian " Na Ca + Al
Bohemian glass is harder + more
refractive than the other
crown glass but [illegible]
[illegible]

shape. If he wants to make
it he proceeds the same as
when only one piece is cast ex-
cept. Wooden plugs are here used.
and. After annealing it is
carried into the "dressing" room
according as it is cooled slowly
or quickly it is tough or brittle
when brought into different
temperature.
Particular care in the cooling
& cooling changes in temperature
is the thing to be most carefully
looked out for

VIII The principle used in glass or
for building furnaces for heating
containing drugs & chemical
compositions &c
Recently a large industry has sprung
up in the glass is used in
ingredients of various stones

XXXII

Insufficient quantity of data to [illegible] the computations [illegible]

[illegible]

[illegible] Geometrical [illegible]

[illegible] Geometrical [illegible] Rectangular [illegible] Polar [illegible] Spherical [illegible] Cylindrical [illegible]

[illegible] Hg

2. Reaction in [illegible] Test [illegible]
[illegible] (1) Substance changes [illegible] globule as S
(2) Substance given which [illegible] salts: NH_3 Hg H_2 &c
(3) Metallic mirror as Hg or H_2
(4) Odour a gas which [illegible] and indicated by [illegible] which [illegible] to Nitrates &c
(a) [illegible] (b) H_2 (c) H_2 (d) H_2 [illegible] to nitrates (e) NH_3 [illegible] (f) H_2 [illegible] to [illegible] if it [illegible] & chlorides [illegible] to organic substances

3. Reaction With Borax Bead [illegible] Hard in Oxy. or Red Test [illegible] Metallic [illegible]

[illegible] Sodium
solution with thiocyanate e.g. Mill
[illegible]
Mill, will you manipulate over in
the oxidizing flame & in [illegible] in
the reducing flame. The reaction of
the [illegible] must be studied in
both flames

4. Reaction with Potassium Dichromate.
This depends on the fact that on
the addition of [illegible] to the
test solution & heating they
give a color to the flame — viz. K
gives violet

5. Reaction on Potassium Ferrocyanide.
[illegible] the potassium ferrocyanide is got
[illegible] by the fusion
[illegible] distance.
[illegible] use all the reactions in
[illegible] chemistry [illegible] we cut out
[illegible] as conclusive as the
[illegible] in [illegible] chemistry.

but they have the advantage of quick fixation.

Hämatoxylin.

The first step is to decalcify the section with solution which requires the 1st treatment. Examination of the substance & next application of a stain.

The instrumental preparation consists in grinding the substance into an impalpable powder & treating it directly in contact with the reagent.

The 1st solvent is entitled H_2O to apply this first because an aqueous solution is easier to effect. Next selected is HCl because HCl is good solvent & substance in HCl is easier treated than one in HNO_3. 3rd solvent HNO_3. HCl is Aqua Regia.

It stands that each substance on application of these solvents

[illegible] in [illegible]. They are [illegible] with [illegible] different [illegible]ment.
After you have brought the substances into relation [illegible] [illegible] of Re[illegible] which [illegible] substances in groups [illegible] [illegible] of 47 of [illegible] + 9

XXVIII

Law of Combination by Weight

[illegible] = 1. [illegible] 16. [illegible]

[illegible] 1st [illegible]

[illegible] which can be combined
with the same element contained in the
same proportion by weight as
A B - 88.89 % C
The second is that given in that
the same element contained in the
same proportions in produces the
same compound
The 2nd is the law of Multiples
Multiple proportions.
If two elements A + B are capable
of uniting in several
proportions the quantities of B
which unite with a given quan-
tity of A regularly bear a simple ra-
tion to each other i.e. least one
is a multiple of the other. as
A + C are above
The 3rd is the law of Equivalents.
If one element A unites with
certain others B & C then the
quantities B & C which combine
with A certain multiples of

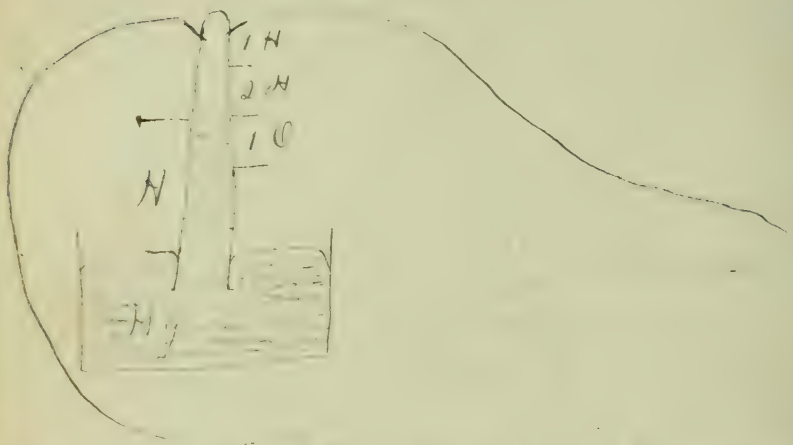
these represent the exact proportion in which they combine together e.g. K 39.1 Cl – 35.5 from which we deduce that one atom of K combines with one atom of Cl in the same proportion. This leads us directly to the Atomic theory

When in the case of compound bodies, the equivalent of a compound is equal to the sum of the equivalents

Law of the combining Volume.

When a liquid or gas unites with another gas in any definite volume but the elements in a gaseous state unite with each other in simple proportions i.e. the combining volume of a molecule of a compound body is 2. This law discovered in 1805 by Gay Lussac & Humboldt & is one of the most

Explanation of the Laws.



If we have 2 volumes of H in
contact with Hg then 1 volume of
O will unite with H_2 + O occupying
two volumes of the then pass
an electric spark through it
it will unite H_2 + O occupying
2 volumes
Molecules of single elements go
in

$$H_2 + Cl_2 = 2\,HCl$$

HCl_2 + AgCl + Hg_2Cl_2 insoluble in N

The Spectroscope.

The Spectroscope is an apparatus [illegible] used for decomposing the [illegible] light by the prism [illegible] range of [illegible] apparatus [illegible] object in spectrum

[illegible] of a Spectroscope.

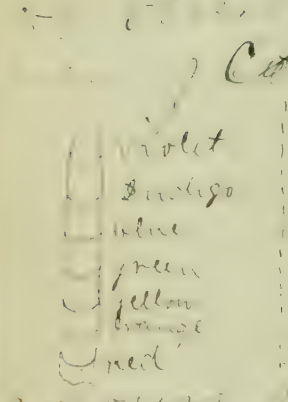
The essential part is a prism [illegible] glass [illegible] [illegible] [illegible] position. Besides this [illegible] [illegible] [illegible] [illegible] front [illegible] [illegible] [illegible] [illegible] [illegible]ting tube

[illegible] the Collimator.

[illegible]

Colours & tunes by Newton

violet
indigo
blue
green
yellow
orange
red



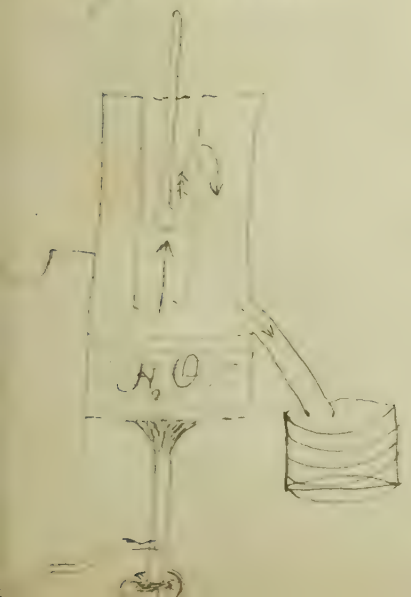
0.000001 of a milligram
0.000006 " "
0.001 " "
0.001 " "

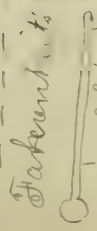
Kirchoff

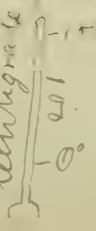
( )

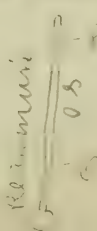
Chemical Physics

II


H_2O


Fahrenh. t°
212°
32°


Centigrade
100°
0°


Reaumur
80°
0°

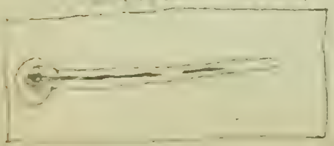
on the

Over the bulb what is called
a weight thermometer. This is not
used in chemistry except to weigh
the bulb full of water with the
stopper in it & weigh the bulb that
part further out then weigh to 20°.
with the [illegible] out

Then to measure [illegible] higher or lower other expedients are used. For measuring [illegible] temperature higher than [illegible] the [illegible] temperature [illegible] [illegible] plates [illegible] & c. One method for measuring higher temperature is by Daniell's Pyrometer. It depends on the fact that metals expand regularly up to 1500° but above that the expansion is irregular

III

It is often necessary to measure [illegible] of temperature. The instrument for recording the greatest temperature is called the Max- [illegible] [illegible] thermometer. One of these is Phillips' thermometer



small hole at the

the furnace & take

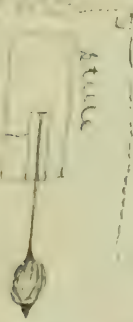
First Effect of heat on Bodies.

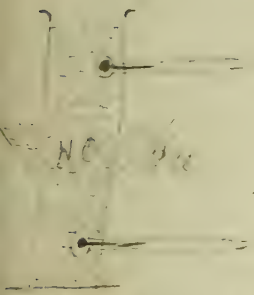
Let us [illegible] expansion then

[illegible] = 0.000017 for [illegible]

[illegible] coefficient.
[illegible] " = 0.000009 } linear ex[illegible]

Sun [illegible] one part in 346
[illegible] " " " " 340
[illegible] " " " " 337





III.

Examples.

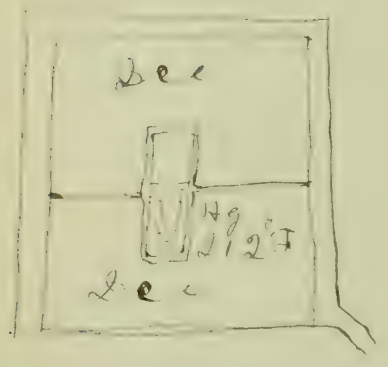
1. Ex. 271. If H at 10°C
find its volume under the same pressure at 100°C.

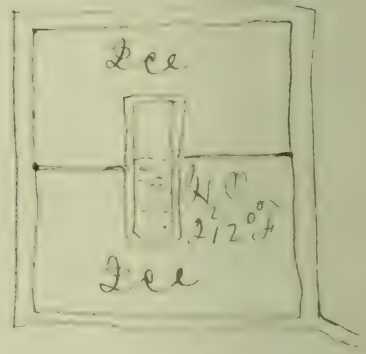
2. Ex. 272 If H at 30°C
find its volume at 0°C the pressure remaining the same

Specific Heat.

If a given weight of H at 0°C
is heated to a given temperature
it will be found that the quantity
of heat required to raise the temperature
of H will be different from the quantity
of heat required to raise the temperature
of an equal weight of water
through the same range of temperature.

We understand by specific heat
of H the amount of heat necessary
to raise a unit weight of H
through a unit range of temperature
as compared with the amount of heat
necessary to raise a unit weight of water
through the same range of temperature.


Lee
Hg
212°F
Lee


Lee
H2O
212°F
Lee

since a the Hg requires 33 times as much as the H_2O

3rd Method of Mixtures

This is the most exact method

$\frac{33}{11} \div \frac{7}{11} = 33$

or

If 1 pound of Hg at 100°F is required to heat 1 pound of H_2O at 40°F to 41°F i.e. 1° then 33 lbs of Hg will heat the H_2O 1°

Specific Heat of Some Substances.

S. H. of C = .11377
" " Fe = .11999
" " Hg = .03332

} S. H. of H_2O = 1.

§ 4

[illegible]

Table 2 of

S. H. of Ice = 0.505 of H. C. S. H. = 1

" " " Bi = 0.106 " " cast " = 1.475

" " " Fe = 0.2377 " H. S. " = 3.414

4 Has the least specific heat of the

the next least

conditions that lessen specific heat

of specific heat of alloys as alloying

increases specific heat diminishes

& vice versa this is true of solids &

liquids & all except Neumann & his

followers say that it is true of gases

and specific heat varies with temperature. This is true of solids & liquids

& Regnault denies it in gases.

3rd specific heat is affected by change

of the physical condition of a body

i.e. as into ice.

The change of the specific heat of a

body is always accompanied with

the change of temperature (quantity between specific heat & temperature) the product of specific heat & either temperature while a diminution of specific heat increases temperature.

A change of density or change of the state of a body always produces a change of temperature.

Dulong that determining matter. This has been found by a number of experiments that specific heat of an element multiplied by the atomic weight is a constant quantity (0.256) or the specific heat of an element varies inversely as the atomic weight.

If a new element was discovered & we would find the atomic weight first finding the specific heat & dividing (0.256 (At wt x S.H.)

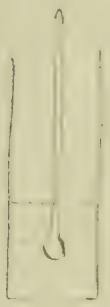
$$\frac{0.256}{S.H.} = At.\ Wt.$$

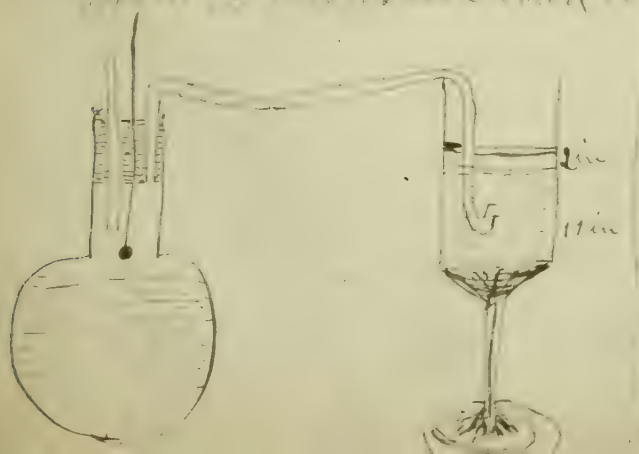
IV.

S. A.

S. A. I A. M. für B. i. 2. 5 für C (Diamond) 3. 3
für Si. 4. 8

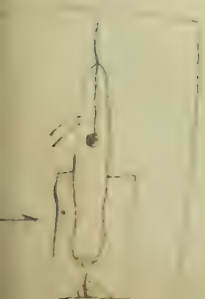
Heat of Fusion.





Two inches of condensed steam will raise 1 inch of H_2O up to 212°
i.e. One inch will boil off 2 inches of H_2O

V



1

[illegible] the boiling point of substances in solution or suspended in a solution the boiling point is raised & of course the more concentrated the solution is the higher will be the boiling point. Thus a solution of salt in water boils at 227°F & contained in the bath boils at 335°F. So to increase the heat of this in chemistry we can evaporate a liquid at any temperature we please by the bath (water + salt + H2SO4 + lead etc).

The [illegible] of the latent heat of the liquid is heat applied from now [illegible] is that the [illegible] formed [illegible] the bottom & traverse must [illegible] itself up [illegible] the boiling point varies according to the containing vessel.

Latent heat of liquid is a state of vapour & substances undergo a change in amount of expansion [e.g. 16 lbs of water in H & heat = 1 cub ft steam at 1 atmosphere pressure & temp 212.

Transmission of heat.

Heat is transmitted in solids by [illegible] from particle to particle

conducting power of some metals.
Cond. pow. of Ag = 100 - that is the best
in their pure & standard
Cond. pow. of Cu = 73.6 of Au = 53.2
" " 33. " Pt 11.9 " Fe 8.2 " Bi 1.8
" also represents the conducting
power for electricity
The conducting power of water is
the same as an insulator &c.

The Ag vessels are superior for
[illegible] by the heat
[illegible] the position of the sediment
in cooling. And the heated sediment
in the flask so as to bring it to
[illegible] boil. Allow ice & cold H2O
[illegible] may say that the conducting
power of [illegible] are lower than
that of solids, for this reason glass
vessels & boiling fluids are warmer
than glass vessels & so [illegible] down
it is warmer than [illegible] down
to the flame & retention we can
handle [illegible] Fe.

Heat transmitted by Radiation.

Laws of Transmission of Heat.

16.

easily through them [illegible] and as the temperature is much higher inside, than outside.

Transmission of heat by liquids.

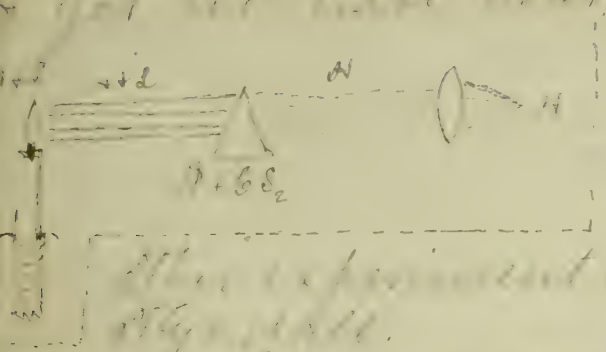
Turpentine	31	100 being the standard
Alcohol	15	
Water	11	

It is supposed that Melloni filled a hollow prism with the different liquids & put the heat on one side & the thermometer on the other & noted how much it rose

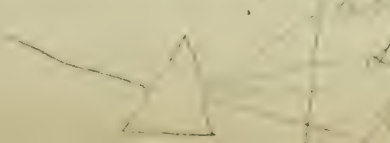
Transmission of heat through Gases.

The most striking thing about this is that all the heat is transmitted through the gases. In the case of one that has moisture on it as is taken out. Air transmits 100 & illuminating gas 970.

Further law connected with the transmission of heat is that bodies wh. prevent the transmission of heat most readily do not permit the transmission of light so readily & vice versa. The light they are all absorbed as in the experiment



be concentrated
in no light.



Acids

1st Neutralize a portion of the solution by NH_4HO + add $BaCl_2$ unless some of the Ag group be present in wh. case add $Ba(NO_3)_2$. If there is a precipitate add dil. HNO_3 in bulk & some HCl. If precipitate does not dissolve then $BaSO_4$ is present. If the precipitate is yellow & dissolves then Chromate ($BaCrO_4$) is present. If white & dissolves $BaSO_3$ $Si(BaO)_4$ [illegible] $B(BaO)_3$ BaF [Ba_3PO_4 Ba_3AsO_4 found in search for bases].

2nd Take another portion of the solution neutralize with $(NH_4)HO$ add $AgNO_3$ and add dilute HNO_3 if precipitate dissolves then Ag_3PO_4 Ag_3AsO_4 Ag_3AsO_3

yellow brick red yellow

Ag_2CrO_4 $Si(AgO)_4$ $B(AgO)_3$ or I [illegible] (white).

dark red precipitate.

If the precipitate does not dissolve then

$AgCl$ $AgCN$ $Ag_4Fe(CN)_6$ $AgBr$ AgI Ag_2S

white yellowish white black

$Ag_3Fe(CN)_6$ ($AgNO_2$) is in none of these divisions because the nitrates are soluble [illegible]

If you have found [illegible] all what [illegible] forms soluble salts with those bases [illegible]. If Ag is present we know that [illegible] is absent because AgCl is insoluble

VI

Magnetism.

In the year 900 B.C. it was known that particular kinds of ore (lodestone) attracted bits of Fe. This kind of ore was first found in Magnesia a town of Lydia & the Greeks called it magnetes & from that comes magnetic & magnetism is the science of the laws of the force exerted by the magnet & substances like magnets. The substances that have this power are Fe, Ni, Co & Mn (their power decreasing in the order named. Mn has this power very slightly). In the lodestone this force is exerted in an uneven degree in different parts. There are two poles to every magnet the North & South poles wh. attract in opposite directions the points on each side of

ic ore in contact with ore ... steel ...
... by bringing the ... contact with a mag-
net. Steel by bringing a magnet along ...
... of a magnetic metal in the same ...
... action for some time. Steel is by mag-
netizing & hardly not by a magnet but by
electricity. If a bar of steel in a coil
& electricity is passed over
it the bar will be magnetic
& if not it will lose it
but if steel it will keep

Process of Magnetic Induction.

... that pole of a magnet is allowed to
... on the Ferrite have Southern polar
ity. i.e. like communicates to unlike &
vice-versa.

... Earth itself is a great magnet &
this accounts for the fact that one needle
... a compass points to N & the other to the
S. i.e. the N pole draws on S & the S on
N. But the N & S magnetic poles of the
... are not coincident with the ...

Electricity

This is the second agent wh. influences chemical action. There are two kinds of electricity, Statical & Chemical or galvanic. Statical electricity is generated by friction & acts instantaneously, galvanic is generated by chemical action & is continuous.

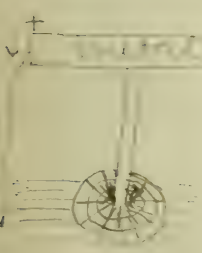
Some years B.C. it was found that certain amber when rubbed with woollen it would draw light bodies.

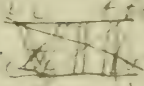
Dr Faraday showed that this power was possessed by other substances e.g. glass & sealing wax.

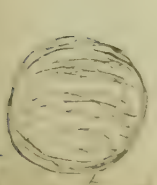
The latter however prevented the electricity from escape. Dr Faraday then discovered the same phenomena when glass & glass bundle.

There is one peculiarity existing between glass & sealing wax & that is that if they are electrified by rubbing they will attract each other & hence either electrified by wax & glass will attract

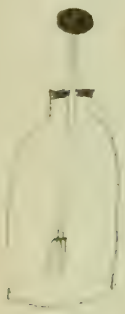
heat. If a crystal of tourmaline is
heated to 300° it will attract small
objects.
3rd by pressure if you press two
different [illegible] pieces [illegible] will
be electrified as shown by the electroscope
4th by fission if sheets of mica are
rapidly electrified
5th by crystallization if [illegible] is allowed
to become crystalline in the
dark we can see the electricity.
For a long time the electricity was
not developed by conduction between
any of the metals was not observed for
the reason that metals conduct off the
electricity as soon as they receive it
in heat. But it is now demonstrated
that all electrical phenomena take
place & they can be manifested
by the metals if they are insulated
i.e. surrounded by non-conductors.
[illegible] substances [illegible]
[illegible] conductors & non-conductors
[illegible] conductors are [illegible] metals







½ in thick + from 9 - 12 inches in [illegible]



the electrified bottle near them if it is
[illegible] they will attract them
if negative they will repel them
Electrified bottle or Electric

VII

Galvanic Electricity.

Galvanic electricity was nearly accidentally discovered by Prof Galvani (Prof. of Anatomy at Bologna) in 1790 while working with [illegible] Galvani's assistant [illegible] touched a dissecting knife [illegible] the legs of a [illegible] frog [illegible] the legs [illegible]. Galvani performed a number of experiments & found that if two metals (e.g. Zn & Pt) [illegible] the nerve [illegible]

connected with the other [illegible] [illegible] shown. Galvani inferred that the electricity [illegible] to the muscles [illegible] muscular motion [illegible] & [illegible] electricity [illegible] But Volta [illegible] [illegible] discovered the [illegible] [illegible] & [illegible] [illegible] the opposite [illegible]-

Question viz that the

& hot controversy

liquid stroke & [illegible]

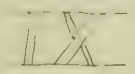
& [illegible] controlled while [illegible]

& complete control. [illegible]

2nd [illegible]

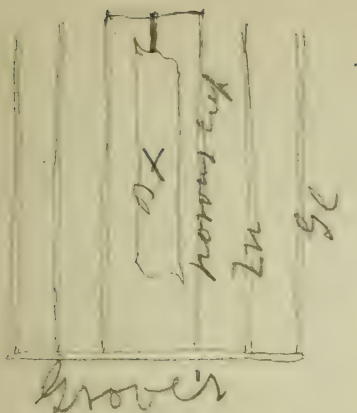
& [illegible]

& the [illegible]



Forms of the Bat

placed in a porous cup
the cup is placed in a
glass or porcelain jar
outside. the jar is
the cylinder filled with dilute
allaround on the
H_2SO_4 + little bichromate in
it. In the porous cell
is placed Zn (rods) $Zn SO_4$ solution
H_2O + water H_2
is passed through the
porous cell then through the tube in the
zinc cylinder + to H_2SO_4 it takes the
Zn from the zinc $ZnSO_4$ the H_2 takes the
O from the zinc cylinder + H_2SO_4 goes back
into the porcelain cell.
This cell was celebrated chromic +
is the most desirable battery for
constant use.
A new form of cell known as (Grenet)
the parts are put together in the



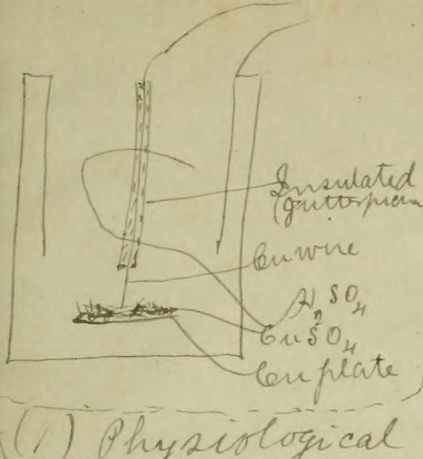
containing dilute H_2SO_4 the cylinders of zinc usually shaved at both ends. Inside the Grove cup is a porous cup through the top of which a rod is suspended a piece of Pt in the porous cup there is strong HNO_3, H_2SO_4 acts as an electrolyte. H flows through the porous cup & attacks HNO_3 $[HNO_3 + H_2 = NO_2 + H_2O]$ & the Pt does not attack the Pt.

The advantage of this battery is its strength. It gives intense current with little variation. The form of the battery in Bunsen. This is Grove's with C substituted for Pt. It is quite as good as Grove's but not as intense but its cheapness makes it the common battery. The C used in this battery is the retort from the gas retort subjected to hydraulic pressure & then moulded.

In the form as ordinarily used Grove's with platinized Pt instead of Pt &

X

Modifications of the Battery.



Another form of this battery Mencotti's + is this battery with sand on the top to separate the two liquids it is said to be superior to all forms [illegible]

Relative Strength of Batteries 100 big

Bünsen = 83.9 Grove = 82.9

Daniels = 47. Smee = 21

Effects of Galvanic Electricity

(1) Physiological effect on the Living + Dead.

After a rabit had been ~~dead~~ suffocated for ½ hour + every sign of life gone a strong current restored vital powers. In Paris an experiment were performed on a human head + it looked like a living head. also on a dead man + he also looked as if he were alive heart beat &c but very weak

(2) Effect on the Living — A single cell gives no shock but two or more gives contraction of the muscles + 50 give a violent shock + 100 often causes death. Advantage has been taken to apply it to medicine. A small class of physicians say that it has a healing effect Begin with a soft current of galvanic + induce the current It is used to restore systems wh. have been overworked also to restore paralized systems

The 2nd effect is the heating effect Whenever electricity is passed through a bad conductor when there is a passing of heat through wires the heat varies inversely as 4th power of the diameter. This is made use of in the firing of mines + torpedoes. + done thus take a wooden bar + pass electricity across the pt wires as seen in the figure

Electricity is applied also in medicine e.g. rap a Pt wire heated to 600° around a cancer or tumor cut it off & it will not bleed & if it is heated to 1500° C it will cut them off like a sharp knife

3rd Effect = Luminosity –

Until the last few years this was not studied on account of the cost & distribution of electricity. Now it is cheap when the current is produced by electrical magnetism as in Gramme's machine. Physiosophers say that it can be distributed & Edison says that he has done it

Pt or C — Heretofore C has been used but now Pt covered with porcelain. This light dont come from combustion but from electricity so a piece of Pt will last as long as you live

All the metals have been fused by electricity & C so softened as to be welded & moulded. Diamond has been volatilized by Dr Ure melted

Use of the Luminosity.

Pt is now used in light houses & in France to light many streets also used in photography. Then it is used in medicine to examine the interior of the body by putting a Pt wire in a glass tube running it down the throat & causing it to come to a white heat

The 4th effect is the chemical effect as already seen in the de-

Cases to decompose salts + used also to ele
troplate i.e. cover with a metal e.g. Ni or Cu
as in Daniell battery